

## PATENT ABSTRACTS OF JAPAN

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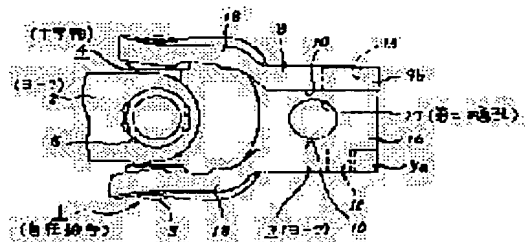
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## (54) COUPLING PART BETWEEN SHAFT AND YOKE OF UNIVERSAL COUPLING

## (57)Abstract:

PROBLEM TO BE SOLVED: To facilitate coupling and fixing work for a shaft and a yoke by forming a second through hole or a thin part in a part of the yoke to lower rigidity between both pressing plates.

SOLUTION: A pair of pressing plates 9a, 9b forming the base end part 8 of a yoke 3 are connected to each other by a circular arc connecting part 16. In the middle part of the connecting part 16, an elliptical second through hole 17 is formed. The bending rigidity of the connecting part 16 is lowered by forming such second through hole 17 on the connecting part 16. Thus, the axial retaining force between the shaft 7 and the yoke 3 can be enlarged by the connecting part between the yoke having the second through hole 17 formed in the connecting part 16 and the shaft. That is, the existence of the connecting part 16 becomes resistance against the force for making both pressing surfaces 10, 10 close to each other, but as the rigidity of the connecting part 16 is lowered by the existence of the through hole 17, the resistance of the connecting part 16 is small.



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**CLAIMS**

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[Claim(s)]

[Claim 1] The shaft rotated at the time of use, and one pair of outside flat surfaces formed in the point peripheral face of this shaft, Have the end face section in which the side carried out opening, and it is mutually isolated with York which constitutes a universal joint, is arranged, and each medial surface as each above-mentioned outside flat surface and a prevention side which counters In the condition which inserted in the through-hole of this alignment or the \*\*\*\* hole, and the through-hole of these mutually of having been formed in 1 pair of prevention Itabe who constitutes the above-mentioned end face section, and both [ these ] prevention Itabe In the bond part of the shaft equipped with the prevention bolt which makes the male screw section formed in the point screw in the above-mentioned \*\*\*\* hole or a nut, and York of a universal joint, by forming the second through-hole or thin-walled part in a part of above-mentioned York The rigidity between both [ these ] prevention Itabe to the force in which it brings close both above-mentioned prevention Itabe generated based on binding of the above-mentioned prevention bolt is reduced. The bond part of the shaft characterized by raising the adhesion of the one above-mentioned pair of outside flat surfaces and each above-mentioned prevention side at the time of binding of the above-mentioned prevention bolt, and York of a universal joint.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] In a steering system, the bond part of the shaft concerning this invention and York of a universal joint is used in order to combine the edge of various shafts and York of a universal joint which constitute this steering system.

[0002]

[Description of the Prior Art] In the steering system for giving a rudder angle to the front wheel of an automobile, the motion of a steering shaft which rotates with actuation of a steering wheel is transmitted to the input shaft of steering gear through the universal joint 1 of a spider type as shown in drawing 6. This universal joint 1 combines one pair of York 2 and three comrades through a spider 4. Four edges established in this spider 4 are supported free [ rocking ] to the point of each above-mentioned York 2 and 3 through the bearing cup 5 and the needle bearing prepared in five, respectively. Therefore, even if the core of both above-mentioned York 2 and 3 is not located on the same straight line, turning effort can be transmitted between both York 2 and three comrades.

[0003] When attaching a steering system using such a universal joint 1, joint immobilization of York [ on the other hand / (method of the right of drawing 6) ] 2 is beforehand carried out by welding or the \*\*\*\* stop at the edge of one shaft 6, such as a steering shaft, and York 3 of another side (left of drawing 6) is combined with the edge of the shaft 7 of another side. After supporting above-mentioned one shaft 6 into a car body, this shaft 6 and the shaft 7 of another side are usually combined with doing such an attachment activity by the universal joint 1.

[0004] Therefore, the so-called thing of the horizontal \*\*\*\* type which can make connection of York 3 of above-mentioned another side at least is desirable among York 2 and 3 of the universal joint 1 which constitutes a steering system, without moving a shaft 6 to shaft orientations. For example, in the case of the universal joint 1 shown in drawing 6, one York 2 is carrying out welding immobilization at the edge of one shaft 6, but as shown in drawing 7, the cross section makes York 3 of another side the thing of the horizontal \*\*\*\* type which has the end face section 8 of U typeface.

[0005] The end face section 8 of York 3 of this horizontal \*\*\*\* type is constituted including 1 pair of prevention Itabe 9a and 9b. These prevention Itabe 9a and 9b that was isolated mutually and has been stationed makes each medial surface mutually the parallel prevention sides 10 and 10. And it \*\*\*\*s by carrying out inner fitting immobilization of the nut 11 in the opening side edge section of prevention Itabe 9a [ on the other hand / (left of drawing 7) ], and the hole 12 is formed. Moreover, the through-hole 13 of a major diameter is formed in the opening side edge section of prevention Itabe 9b of another side rather than this screw-thread hole 12 by this screw-thread hole 12 and this alignment, respectively. In addition, the \*\*\*\* hole 12 may be directly formed in the above-mentioned prevention Itabe 9a, as shown in drawing 9. Moreover, there is also a thing of the structure which does not carry out fitting immobilization of the nut 11 in York 3.

[0006] The shaft 7 which has the point combined by York 3 constituted as mentioned above on the other hand is made into the ellipse as shows the cross-section configuration of a point to drawing 8 at least. That is, rotation prevention of the shaft 7 to above-mentioned York 3 is aimed at by forming one pair of parallel outside flat surfaces 14 and 14 in the point peripheral face of this shaft 7 mutually, and making close to it these outside flat surfaces 14 and 14 and the above-mentioned prevention sides 10 and 10 at the time of connection.

[0007] In carrying out connection immobilization of the edge of the shaft 7 which has the above configurations at the end face section 8 of above York 3, as a continuous line shows to drawing 6, it arranges the edge of the above-mentioned shaft 7 to the opening side of the above-mentioned end face section 8 first. And from this condition, by rotating above-mentioned York 3 focusing on a spider 4, for example, this York 3 is made to rock even from the continuous-line condition of drawing 6 to a chain-line condition clockwise in this drawing, and the edge of the above-mentioned shaft 7 is inserted into the end face section 8 of York 3. In addition, the edge of a shaft 7 may be inserted into the end face section 8 of York 3 by moving the edge of a shaft 7, without moving York 3. Anyway, before inserting the edge of a shaft 7 into the end face section 8, it holds down to the above-mentioned through-hole 13, and a bolt (illustration abbreviation) is not inserted.

[0008] If the edge of a shaft 7 is inserted into the end face section 8 of York 3 as mentioned above and each above-mentioned prevention sides 10 and 10 and the outside flat surfaces 14 and 14 ( drawing 7 -8) are made to counter, the male screw section which was inserted in the above-mentioned through-hole 13 and which was stopped and was formed in the point of a bolt (not shown) will be screwed in the above-mentioned \*\*\*\* hole 12, and will be bound further. Based on this binding, narrowing, each [ these ] prevention sides 10 and 10, and each above-

mentioned outside flat surfaces 14 and 14 contact [ spacing of the one above-mentioned pair of prevention sides 10, and ten comrades ] strongly, and joint immobilization of the point of the above-mentioned shaft 7 is carried out at the above-mentioned end face section 8. In addition, also if this prevention bolt should loosen while forming notching 15 in the edge piece edge of the above-mentioned shaft 7 and preventing interference with this shaft 7 and the rod part of the above-mentioned prevention bolt, it has prevented that above-mentioned York 3 falls out to the shaft orientations of a shaft 7.

[0009]

[Problem(s) to be Solved by the Invention] That joint immobilization of York 3 and the shaft 7 should be carried out, when [ which was screwed in the screw-thread hole 12 of York 3 ] stopping and binding a bolt, 1 pair of prevention Itabe 9a and 9b who constitutes this York 3 does elastic deformation in proportion to the torque which binds the above-mentioned prevention bolt. On the other hand, in narrow space like [ in an engine room ], 1 above-mentioned pair of prevention Itabe 9a, In order to make the activity which inserts the edge of the above-mentioned shaft 7 among 9b do easily, as shown in drawing 10 , the one above-mentioned pair of prevention Itabe's 9a and 9b prevention sides 10, and the spacing D10 of ten comrades Width of face W7 of this shaft 7 which is the outside flat surface 14 of the above-mentioned shaft 7, and spacing of 14 comrades It enlarges ( $D10 > W7$ ).

[0010] Therefore, after inserting the edge of the above-mentioned shaft 7 between prevention Itabe 9a of above-mentioned York 3, and 9b, even if it binds the above-mentioned prevention bolt Both [ these ] prevention Itabe 9a and 9b is the above-mentioned spacing D10 and width of face W7. Until it carries out elastic deformation by the difference ( $D10 - W7$ ) Both above-mentioned prevention Itabe's 9a and 9b prevention sides 10 and 10 and the outside flat surfaces 14 and 14 of a shaft 7 are not close, and joint immobilization of the above-mentioned shaft 7 and York 3 is not carried out. The force consumed in order to carry out elastic deformation of each above-mentioned prevention Itabe 9a and 9b is not used in order to carry out joint immobilization of the above-mentioned shaft 7 and York 3, until in other words these prevention sides 10 and 10 and the outside flat surfaces 14 and 14 are close.

[0011] Consequently, in order to fully secure the bond strength of the above-mentioned shaft 7 and York 3, torque for binding the above-mentioned prevention bolt must be enlarged fairly. It is troublesome to bind this prevention bolt with torque big enough in narrow space, and since it becomes the cause which bars the promotion of efficiency of the activity which combines a shaft 7 and York 3, it is not desirable. If the torque which binds the above-mentioned prevention bolt is not fully securable on the contrary, the bond strength of the above-mentioned shaft 7 and York 3 runs short, and if setting etc. arises after prolonged progress in some of both [ these ] members 7 and 3 or prevention bolts, possibility that shakiness will occur in the bond part of both [ these ] the members 7 and three comrades will arise.

[0012] Moreover, even when the above-mentioned prevention bolt is bound with sufficient torque, it is easy to become in the one above-mentioned pair of prevention Itabe's 9a and 9b prevention sides 10 and ten comrades not being parallel to as, and each [ these ] prevention sides 10 and 10 and the outside flat surfaces 14 and 14 of the above-mentioned shaft 7 carry out per piece (homogeneity is not contacted). Consequently, it becomes easy to generate shakiness in the bond part of both the above-mentioned members 7 and three comrades too. Such shakiness is not desirable in order to give sense of incongruity to the operator who operates a steering wheel. abolish such a problem, if the above-mentioned difference ( $D10 - W7$ ) is made small — since a combination activity with York 3 and a shaft 7 becomes troublesome, \*\* cannot adopt.

[0013] Moreover, if board thickness of the metal plate which constitutes above-mentioned York 3 is made small or a degree of hardness is reduced in order raise the adhesion of the above-mentioned prevention sides 10 and 10 and the outside flat surfaces 14 and 14 and to reduce the one above-mentioned pair of prevention Itabe's 9a and 9b rigidity It becomes easy to deform the part protruded from each above-mentioned outside flat surfaces 14 and 14 by each above-mentioned prevention Itabe's 9a and 9b point plastically with binding of the above-mentioned prevention bolt in the direction which approaches mutually. Spacing of the one above-mentioned pair of prevention Itabe's 9a and 9b tip edges is the width of face W7 of the above-mentioned shaft 7 as a result of this plastic deformation. When it becomes small, it becomes impossible to decompose above-mentioned York 3 and a shaft 7 for check, repair, etc. furthermore, the big torque which joins the bond part of above-mentioned York 3 and a shaft 7 by the busy condition when reducing the degree of hardness of the above-mentioned metal plate — a part of above-mentioned York 3 (especially prevention sides 10 and 10) — setting — being easy — when passing up, backlash will occur in the above-mentioned bond part, and sense of incongruity will be given to an operator. In view of such a situation, this invention can do easily a joint fixed activity with a shaft 7 and York 3, and invents it that shakiness should be made hard to generate in the bond part of both [ these ] the members 7 and three comrades moreover.

[0014]

[Means for Solving the Problem] The bond part of the shaft of this invention and York of a universal joint One pair of outside flat surfaces formed in the point peripheral face of the shaft rotated at the time of use, and this shaft like the bond part of the conventional shaft and York of a universal joint which were mentioned above, and a cross-section abbreviation U typeface (the configuration in which the side carried out opening is said, and a KO typeface is included.) Have the end face section in which the side carried out opening, and it is mutually isolated with York which constitutes a universal joint, is arranged, and each medial surface as each above-mentioned outside flat surface and a prevention side which counters It has the prevention bolt which makes the male screw section formed in that point screw in the above-mentioned \*\*\*\* hole or a nut in the condition which inserted in the through-hole of this alignment or the \*\*\*\* hole, and the through-hole of these mutually of having been formed in 1 pair of

prevention Itabe who constitutes the above-mentioned end face section, and both [ these ] prevention Itabe.

[0015] It sets to the bond part of the shaft of this invention, and York of a universal joint especially. By forming the second through-hole or thin-walled part in a part of above-mentioned York The rigidity between both [ these ] prevention Itabe to the force in which it brings close both above-mentioned prevention Itabe generated based on binding of the above-mentioned prevention bolt is reduced, and the adhesion of the one above-mentioned pair of outside flat surfaces and each above-mentioned prevention side at the time of binding of the above-mentioned prevention bolt is raised. For this reason, the second through-hole or thin-walled part is formed in the connection section which one pair of prevention Itabe which constitute the end face section of \*\* above-mentioned York is made to follow for example. To a part for Mabe with the arm which extends to shaft orientations from the part which the flexural rigidity of this connection section was reduced, or formed the through-hole or the \*\*\*\* hole in a part of \*\* above-mentioned York, and the above-mentioned end face section, and supports the edge of a spider pivotably in that point The second through-hole or thin-walled part is formed, and flexural rigidity for this Mabe is reduced.

[0016]  
[Function] According to the bond part of the shaft of this invention and York of a universal joint which are constituted as mentioned above, holding power covering the shaft orientations of a shaft and York can be enlarged. Namely, the rigidity between both [ these ] prevention Itabe to the force in which it brings both prevention Itabe close is reduced. Since the adhesion of the one above-mentioned pair of outside flat surfaces and each above-mentioned prevention side at the time of binding of the above-mentioned prevention bolt is raised, even if it does not enlarge especially torque which binds this prevention bolt, the one above-mentioned pair of outside flat surfaces and each above-mentioned prevention side stick, and the bond strength of a shaft and York can be secured.

[0017]  
[Embodiment of the Invention] Drawing 1 -2 show the 1st example of the gestalt of operation of this invention. In addition, the description of this invention sticks one pair of prevention Itabe's 9a and 9b prevention sides 10 and 10 and the outside flat surfaces 14 and 14 ( drawing 8 , 10) of a shaft 7 which are not illustrated and which stop and constitute York 3 based on binding of a bolt, and is in the structure for securing the bond strength of these York 3 and a shaft 7. the illustration and explanation about an equivalent part since the structure of other parts and an operation are the same as that of structure conventionally which was mentioned above -- an abbreviation -- or it is made simple and explains focusing on the description part of this invention hereafter.

[0018] 1 pair of prevention Itabe 9a which constitutes the end face section 8 of York 3, and 9b are mutually connected by the connection section 16 of a radii form. And the second through-hole 17 of an ellipse form is formed in the pars intermedia of this connection section 16. The direction of the major axis of this second through-hole 17 is making that edge in agreement with the above-mentioned end face section 8 in the shaft orientations of the shaft 7 ( drawing 6 ) which should carry out joint immobilization. By forming such second through-hole 17 in the above-mentioned connection section 16, the flexural rigidity of the above-mentioned connection section 16 is reduced.

[0019] Thus, according to the bond part of the York and the shaft which formed the second through-hole 17 in the connection section 16, holding power covering the shaft orientations of a shaft 7 and York 3 can be enlarged. That is, after inserting the edge of a shaft 7 in the end face section 8 of above-mentioned York 3, the prevention side 10 of 1 pair of prevention Itabe 9a and 9b who inserted in the through-hole 13 and from whom the above-mentioned end face section 8 is constituted if stop, a bolt is \*\*\*\*ed, it screws in a hole 12 and it binds further, and spacing of ten comrades are shortened. By existence of the above-mentioned through-hole 17, although existence of the above-mentioned connection section 16 serves as resistance to both [ these ] the prevention side 10 and the force in which it brings ten comrades close, since it is low, the rigidity of this connection section 16 is small, and the resistance by this connection section 16 ends. Therefore, one pair of outside flat surfaces 14 and 14 ( drawing 6 , 8) established in the edge of the above-mentioned shaft 7 with binding of the above-mentioned prevention bolt and each above-mentioned prevention sides 10 and 10 stick effectively. That is, even if it does not enlarge especially torque which binds the above-mentioned prevention bolt, the one above-mentioned pair of outside flat surfaces 14 and 14 and each above-mentioned prevention sides 10 and 10 stick to homogeneity almost strongly, and can secure the bond strength of a shaft 7 and York 3.

[0020] Next, drawing 3 shows the 2nd example of the gestalt of operation of this invention. In this example, the second through-hole 19 is formed in a part for Mabe, the part which formed the through-hole 13 (or \*\*\*\* hole 12) in a part of York 3, and one pair of arms 18 which extend from the end face section 8 to shaft orientations, and support the edge of a spider 4 ( drawing 6 , 9) pivotably in each point, respectively, and the flexural rigidity of each [ these ] \*\*\*\*\* is reduced. In the case of York 3 as shown in drawing 3 , if it remains as it is, the elastic deformation of 1 pair which formed these through-hole 13 or \*\*\*\* hole 12 even if it stopped and bound bolt of prevention Itabe 9a and 9b ( drawing 2 ) whom the rigidity of the part in which the through-hole 13 (or \*\*\*\* hole 12) was formed is uneven, inserted in and \*\*\*\*ed the through-hole 13, and screwed in the hole 12 becomes an ununiformity. On the other hand, in this example, since the second through-hole 19 of the above is formed in the part to which rigidity becomes high, the rigid difference in the one above-mentioned pair of each fields of prevention Itabe 9a and 9b decreases. Consequently, one pair of outside flat surfaces 14 and 14 and each above-mentioned prevention sides 10 and 10 ( drawing 10 ) which were formed in the edge of a shaft 7 with binding of the above-mentioned prevention bolt stick effectively, and can secure the bond strength of a shaft 7 and York 3.

[0021] Next, drawing 4 shows the 3rd example of the gestalt of operation of this invention. It forms [ the shaft orientations of the shaft 7 ( drawing 6 ) which should carry out a thin-walled part 20 in the pars intermedia of the

connection section 16 which connects 1 pair of prevention Itabe 9a which constitutes the end face section 8 of York 3, and 9b in this example, and should carry out joint immobilization of the edge at the above-mentioned end face section 8 ]. By forming such a thin-walled part 20 in the above-mentioned connection section 16, the flexural rigidity of the above-mentioned connection section 16 is reduced. Thus, in order to reduce the flexural rigidity of the connection section 16, the configuration and operation of those other than the point which replaced with the second through-hole 17 ( drawing 1 -2), and formed the thin-walled part 20 are the same as that of the 1st example mentioned above.

[0022] Next, drawing 5 shows the 4th example of the gestalt of operation of this invention. In this example, thin-walled parts 21 and 21 are formed in a part for Mabe, the part which formed the through-hole 13 (or \*\*\*\* hole 12) in a part of York 3, and the arms 18 and 18 which extend from the end face section 8 to shaft orientations, and support the edge of a spider 4 ( drawing 6 , 9) pivotably in each point, and the flexural rigidity for this Mabe is reduced. In order to reduce the flexural rigidity for this Mabe, the configuration and operation of those other than the point which replaced with the second through-hole 19 ( drawing 3 ), and formed thin-walled parts 21 and 21 are the same as that of the 2nd example mentioned above. In addition, the 1-4th example of the gestalt of operation mentioned above can be combined suitably, and can also be carried out. Moreover, the polygon cross section in which what [ not only ] has one pair of parallel outside flat surfaces 14 and 14 mutually but a hexagon and serration were formed etc. can be carried out also in the structure of having other cross-section configurations, also about the cross-section configuration of a shaft 7.

[0023]

[Effect of the Invention] Shakiness can be made hard to carry out joint immobilization of a shaft and York certainly, and to generate also by use over a long period of time, even if it does not enlarge especially torque which binds a prevention bolt, since the bond part of the shaft of this invention and York of a universal joint is constituted as it was stated above, and it acts. Moreover, association with a shaft and York becomes easy. Furthermore, since association with York and a shaft can be ensured even if it enlarges thickness of the metal plate which constitutes York or makes a degree of hardness high, improvement in on the strength as whole York can be aimed at.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] The partial side elevation of the universal joint incorporating York showing the 1st example of the gestalt of operation of this invention.

[Drawing 2] Drawing which omitted the part and was seen from the method of the right of drawing 1 .

[Drawing 3] The side elevation of York showing the 2nd example of the gestalt of operation of this invention.

[Drawing 4] The same drawing as drawing 2 showing this 3rd example.

[Drawing 5] The same drawing as drawing 1 showing this 4th example.

[Drawing 6] The side elevation showing the condition of combining the edge of a shaft, and the end face section of York, with the structure set as the object of this invention.

[Drawing 7] The A-A sectional view of drawing 6 .

[Drawing 8] This B-B sectional view.

[Drawing 9] The same drawing as drawing 1 showing example of another of structure conventionally.

[Drawing 10] The sectional view showing the dimension relation between the end face section of York, and the edge of a shaft.

[Description of Notations]

1 Universal Joint

2 Three York

4 Spider

5 Bearing Cup

6 Seven Shaft

8 End Face Section

9a, 9b Prevention Itabe

10 Prevention Side

11 Nut

12 Screw-Thread Hole

13 Through-hole

14 Outside Flat Surface

15 Notching

16 Connection Section

17 Second Through-hole

18 Arm

19 Second Through-hole

20 21 Thin-walled part

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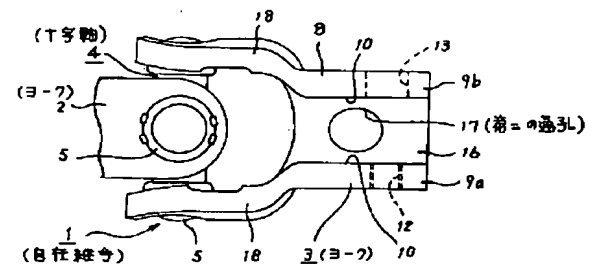
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(54) 【発明の名称】 シャフトと自在継手のヨークとの結合部

(57) 【要約】

【目的】 通孔13を押通しねじ孔12に螺合した抑えボルトの緊締トルクを特に大きくしなくても、自在継手を構成するヨーク3とシャフトとの結合強度を確保する。

【構成】 ヨーク3の基端部8を構成する1対の抑え板部9a、9b同士を連結する連結部16に第二の通孔17を形成し、この連結部16の剛性を低下させる。連結部16の剛性が低い分、抑えボルトの緊締に伴って上記1対の抑え板部9a、9bの抑え面10、10が、シャフトの端部に形成した外側平面に効果的に当接する。





## 【特許請求の範囲】

【請求項1】 使用時に回転するシャフトと、このシャフトの先端部外周面に形成された1対の外側平面と、側方が開口した基端部を有し、自在継手を構成するヨークと、互いに離隔して配置され、それぞれの内側面を上記各外側平面と対向する抑え面として、上記基端部を構成する1対の抑え板部と、これら両抑え板部に形成された、互いに同心の通孔若しくはねじ孔と、このうちの通孔を挿通した状態で、その先端部に形成した雄ねじ部を上記ねじ孔若しくはナットに螺合させる抑えボルトとを備えたシャフトと自在継手のヨークとの結合部に於いて、上記ヨークの一部に第二の通孔若しくは薄肉部を形成する事により、上記抑えボルトの緊締に基づいて発生する、上記両抑え板部同士を近づけようとする力に対するこれら両抑え板部同士の間の剛性を低下させて、上記抑えボルトの緊締時に於ける上記1対の外側平面と上記各抑え面との密着性を向上させた事を特徴とするシャフトと自在継手のヨークとの結合部。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】この発明に係るシャフトと自在継手のヨークとの結合部は、例えばステアリング装置に於いて、このステアリング装置を構成する各種シャフトの端部と自在継手のヨークとを結合する為に利用する。

## 【0002】

【従来の技術】自動車の前輪に舵角を付与する為のステアリング装置では、ステアリングホイールの操作に伴って回転するステアリングシャフトの動きを、図6に示す様な十字軸式の自在継手1を介して、ステアリングギヤの入力軸に伝達する。この自在継手1は、1対のヨーク2、3同士を十字軸4を介して結合したものである。この十字軸4に設けられた4個所の端部は、それぞれ上記各ヨーク2、3の先端部に、軸受カップ5、5内に設けられたニードル軸受を介して揺動自在に支持している。従って、上記両ヨーク2、3の中心が同一直線上に位置しなくても、両ヨーク2、3同士の間で回転力の伝達を行なえる。

【0003】この様な自在継手1を使用してステアリング装置を組み付ける場合、例えば一方（図6の右方）のヨーク2をステアリングシャフト等の一方のシャフト6の端部に、溶接或はねじ止め等により予め結合固定し、他方（図6の左方）のヨーク3を他方のシャフト7の端部に結合する。この様な組み付け作業を行なうのに通常は、上記一方のシャフト6を車体に支持した後、このシャフト6と他方のシャフト7とを自在継手1により結合する。

【0004】従って、ステアリング装置を構成する自在継手1のヨーク2、3のうち、少なくとも上記他方のヨーク3は、シャフト6を軸方向に動かす事なく接続作業を行なえる、所謂横入れ式のものが好ましい。例えば図

6に示した自在継手1の場合、一方のヨーク2は一方のシャフト6の端部に溶接固定しているが、他方のヨーク3は、図7に示す様に、断面がU字形の基端部8を有する、横入れ式のものとしている。

【0005】この横入れ式のヨーク3の基端部8は、1対の抑え板部9a、9bを含んで構成される。互いに離隔して配置されたこれら抑え板部9a、9bは、それぞれの内側面を、互いに平行な抑え面10、10としている。そして、一方（図7の左方）の抑え板部9aの開口側端部にナット11を内嵌固定する事によりねじ孔12を設けている。又、他方の抑え板部9bの開口側端部に、このねじ孔12と同心でこのねじ孔12よりも大径の通孔13を、それぞれ形成している。尚、ねじ孔12は、図9に示す様に、上記抑え板部9aに直接形成する場合もある。又、ナット11をヨーク3に嵌合固定しない構造のものもある。

【0006】一方、上述の様に構成されるヨーク3に、その先端部を結合されるシャフト7は、少なくとも先端部の断面形状を、図8に示す様な小判形としている。即ち、このシャフト7の先端部外周面に、互いに平行な1対の外側平面14、14を形成し、接続時にはこの外側平面14、14と上記抑え面10、10とを密接させる事により、上記ヨーク3に対するシャフト7の回転防止を図る。

【0007】上述の様な形状を有するシャフト7の端部を前述の様なヨーク3の基端部8に接続固定する場合には、先ず、図6に実線で示す様に、上記シャフト7の端部を上記基端部8の開口側に配置する。そして、この状態から、例えば上記ヨーク3を十字軸4を中心に回転させる事により、このヨーク3を図6の実線状態から鎖線状態にまで、同図で時計方向に揺動させて、上記シャフト7の端部をヨーク3の基端部8内に挿入する。尚、ヨーク3を動かさずにシャフト7の端部を動かす事で、シャフト7の端部をヨーク3の基端部8内に挿入する場合もある。何れにしても、シャフト7の端部を基端部8内に挿入する以前には、上記通孔13に抑えボルト（図示省略）を挿入しない。

【0008】上述の様にシャフト7の端部をヨーク3の基端部8内に挿入し、上記各抑え面10、10と外側平面14、14（図7～8）とを対向させたならば、上記通孔13に挿通した抑えボルト（図示せず）の先端部に形成した雄ねじ部を上記ねじ孔12に螺合し、更に緊締する。この緊締に基づき、上記1対の抑え面10、10同士の間隔が狭まり、これら各抑え面10、10と上記各外側平面14、14とが強く当接して、上記シャフト7の先端部が上記基端部8に結合固定される。尚、上記シャフト7の端部片縁部には切り欠き15を形成して、このシャフト7と上記抑えボルトの杆部との干渉を防止すると共に、万一この抑えボルトが緩んだ場合にも、上記ヨーク3がシャフト7の軸方向に抜けるのを防

止している。

【0009】

【発明が解決しようとする課題】ヨーク3とシャフト7とを結合固定すべく、ヨーク3のねじ孔12に螺合した抑えボルトを緊締する場合に、このヨーク3を構成する1対の抑え板部9a、9bは、上記抑えボルトを緊締するトルクに比例して弾性変形する。一方、エンジンルーム内の様な狭い空間内で、上記1対の抑え板部9a、9b同士の間には上記シャフト7の端部を挿入する作業を容易に行なわせる為、図10に示す様に、上記1対の抑え板部9a、9bの抑え面10、10同士の間隔 $D_{10}$ は、上記シャフト7の外側平面14、14同士の間隔である、このシャフト7の幅 $W$ 、よりも大きく( $D_{10} > W$ )している。

【0010】従って、上記シャフト7の端部を上記ヨーク3の抑え板部9a、9b同士の間には挿入した後、上記抑えボルトを緊締しても、これら両抑え板部9a、9bが、上記間隔 $D_{10}$ と幅 $W$ 、との差( $D_{10} - W$ )分だけ弾性変形するまでの間は、上記両抑え板部9a、9bの抑え面10、10とシャフト7の外側平面14、14とが密接せず、上記シャフト7とヨーク3とが結合固定される事はない。言い換えれば、これら抑え面10、10と外側平面14、14とが密接するまでの間、上記各抑え板部9a、9bを弾性変形させる為に消費した力は、上記シャフト7とヨーク3とを結合固定する為に利用されない。

【0011】この結果、上記シャフト7とヨーク3との結合強度を十分に確保する為には、上記抑えボルトを緊締する為のトルクを相当に大きくしなければならない。狭い空間内でこの抑えボルトを十分に大きなトルクで緊締する事は面倒で、シャフト7とヨーク3とを結合する作業の能率化を妨げる原因となる為、好ましくない。反対に、上記抑えボルトを緊締するトルクを十分に確保できないと、上記シャフト7とヨーク3との結合強度が不足し、長期間経過後にこれら両部材7、3或は抑えボルトの一部にへたり等が生じると、これら両部材7、3同士の結合部にがたつきが発生する可能性が生じる。

【0012】又、上記抑えボルトを十分なトルクで緊締した場合でも、上記1対の抑え板部9a、9bの抑え面10、10同士が非平行のままとなり易く、これら各抑え面10、10と上記シャフト7の外側平面14、14とが片当たりしてしまう(均一に当接しない)。この結果、やはり上記両部材7、3同士の結合部にがたつきが発生し易くなる。この様ながたつきは、ステアリングホイールを操作する運転者に違和感を与える為、好ましくない。上記差( $D_{10} - W$ )を小さくすれば、この様な問題をなくせるが、ヨーク3とシャフト7との組み合わせ作業が面倒になる為、採用できない。

【0013】又、上記抑え面10、10と外側平面1

4、14との密着性を向上させるべく、上記1対の抑え

板部9a、9bの剛性を低下させる為、上記ヨーク3を構成する金属板の板厚を小さくしたり、或は硬度を低下させると、上記抑えボルトの緊締に伴って、上記各抑え板部9a、9bの先端部で上記各外側平面14、14からはみ出した部分が互いに近づく方向に塑性変形し易くなる。この塑性変形の結果、上記1対の抑え板部9a、9bの先端縁同士の間隔が、上記シャフト7の幅 $W$ 、よりも小さくなると、点検・修理等の為に上記ヨーク3とシャフト7とを分解する事ができなくなる。更に、上記金属板の硬度を低下させた場合には、使用状態で上記ヨーク3とシャフト7との結合部に加わる大きなトルクにより、上記ヨーク3の一部(特に抑え面10、10)がへたり易くなり、へたった場合には、上記結合部にガタが発生して、運転者に違和感を与えてしまう。本発明は、この様な事情に鑑みて、シャフト7とヨーク3との結合固定作業を容易に行なえ、しかもこれら両部材7、3同士の結合部にがたつきが発生しにくくすべく発明したものである。

【0014】

【課題を解決するための手段】本発明のシャフトと自在継手のヨークとの結合部は、前述した従来のシャフトと自在継手のヨークとの結合部と同様に、使用時に回転するシャフトと、このシャフトの先端部外周面に形成された1対の外側平面と、断面略U字形(側方が開口した形状を言い、コ字形を含む。)で側方が開口した基端部を有し、自在継手を構成するヨークと、互いに離隔して配置され、それぞれの内側面を上記各外側平面と対向する抑え面として、上記基端部を構成する1対の抑え板部と、これら両抑え板部に形成された、互いに同心の通孔若しくはねじ孔と、このうちの通孔を挿通した状態で、その先端部に形成した雄ねじ部を上記ねじ孔若しくはナットに螺合させる抑えボルトとを備える。

【0015】特に、本発明のシャフトと自在継手のヨークとの結合部に於いては、上記ヨークの一部に第二の通孔若しくは薄肉部を形成する事により、上記抑えボルトの緊締に基づいて発生する、上記両抑え板部同士を近づけようとする力に対するこれら両抑え板部同士の間隔の剛性を低下させて、上記抑えボルトの緊締時に於ける上記1対の外側平面と上記各抑え面との密着性を向上させる。この為に例えば、

① 上記ヨークの基端部を構成する1対の抑え板部同士を連続させる連結部に第二の通孔或は薄肉部を形成して、この連結部の曲げ剛性を低下させたり、

② 上記ヨークの一部で通孔若しくはねじ孔を形成した部分と上記基端部から軸方向に延出してその先端部に十字軸の端部を枢支する腕部との間部分に、第二の通孔或は薄肉部を形成して、この間部分の曲げ剛性を低下させたりする。

【0016】

【作用】上述の様に構成される本発明のシャフトと自在

継手のヨークとの結合部によれば、シャフトとヨークとの軸方向に互る保持力を大きくできる。即ち、両抑え板部同士を近づけようとする力に対するこれら両抑え板部同士の間の剛性を低下させて、上記抑えボルトの緊締時に於ける上記1対の外側平面と上記各抑え面との密着性を向上させている為、この抑えボルトを緊締するトルクを特に大きくしなくても、上記1対の外側平面と上記各抑え面とが密着し、シャフトとヨークとの結合強度を確保できる。

【0017】

【発明の実施の形態】図1～2は、本発明の実施の形態の第1例を示している。尚、本発明の特徴は、図示しない抑えボルトの緊締に基づき、ヨーク3を構成する1対の抑え板部9a、9bの抑え面10、10とシャフト7の外側平面14、14（図8、10）とを密着させ、これらヨーク3とシャフト7との結合強度を確保する為の構造にある。その他の部分の構造及び作用は、前述した従来構造と同様であるから、同等部分に関する図示及び説明は、省略若しくは簡略にし、以下、本発明の特徴部分を中心に説明する。

【0018】ヨーク3の基端部8を構成する1対の抑え板部9a、9b同士は、円弧形的の連結部16により、互いに連結している。そして、この連結部16の中間部には、楕円形の第二の通孔17を形成している。この第二の通孔17の長径の方向は、上記基端部8にその端部を結合固定すべきシャフト7（図6）の軸方向に一致させている。この様な第二の通孔17を上記連結部16に形成する事により、上記連結部16の曲げ剛性を低下させている。

【0019】この様に連結部16に第二の通孔17を形成したヨークとシャフトとの結合部によれば、シャフト7とヨーク3との軸方向に互る保持力を大きくできる。即ち、上記ヨーク3の基端部8にシャフト7の端部を挿入した後、通孔13を挿通した抑えボルトをねじ孔12に螺合し更に緊締すると、上記基端部8を構成する1対の抑え板部9a、9bの抑え面10、10同士の間隔が縮まる。上記連結部16の存在は、これら両抑え面10、10同士を近づけようとする力に対する抵抗となるが、この連結部16の剛性は、上記通孔17の存在により低い為、この連結部16による抵抗は小さくて済む。従って、上記抑えボルトの緊締に伴って上記シャフト7の端部に設けた1対の外側平面14、14（図6、8）と、上記各抑え面10、10とが効果的に密着する。即ち、上記抑えボルトを緊締するトルクを特に大きくしなくても、上記1対の外側平面14、14と上記各抑え面10、10とがほぼ均一に強く密着し、シャフト7とヨーク3との結合強度を確保できる。

【0020】次に、図3は、本発明の実施の形態の第2例を示している。本例の場合には、ヨーク3の一部で通孔13（若しくはねじ孔12）を形成した部分と、基端

部8から軸方向に延出してそれぞれの先端部に十字軸4（図6、9）の端部を枢支する1対の腕部18との間部分に、それぞれ第二の通孔19を形成して、これら各間部分の曲げ剛性を低下させている。図3に示す様なヨーク3の場合、そのままでは通孔13（若しくはねじ孔12）を形成した部分の剛性が不均一であり、通孔13を挿通してねじ孔12に螺合した抑えボルトを緊締しても、これら通孔13或はねじ孔12を形成した1対の抑え板部9a、9b（図2）の弾性変形が不均一になる。これに対して本例の場合には、剛性が高くなる部分に上記第二の通孔19を形成している為、上記1対の抑え板部9a、9bのそれぞれの面での剛性の差が少なくなる。この結果、上記抑えボルトの緊締に伴ってシャフト7の端部に形成した1対の外側平面14、14と上記各抑え面10、10（図10）とが効果的に密着し、シャフト7とヨーク3との結合強度を確保できる。

【0021】次に、図4は、本発明の実施の形態の第3例を示している。本例の場合には、ヨーク3の基端部8を構成する1対の抑え板部9a、9b同士を連結する連結部16の中間部に薄肉部20を、上記基端部8にその端部を結合固定すべきシャフト7（図6）の軸方向に互って形成している。この様な薄肉部20を上記連結部16に形成する事により、上記連結部16の曲げ剛性を低下させている。この様に連結部16の曲げ剛性を低下させる為、第二の通孔17（図1～2）に代えて薄肉部20を形成した点以外の構成及び作用は、前述した第1例と同様である。

【0022】次に、図5は、本発明の実施の形態の第4例を示している。本例の場合には、ヨーク3の一部で通孔13（若しくはねじ孔12）を形成した部分と、基端部8から軸方向に延出してそれぞれの先端部に十字軸4（図6、9）の端部を枢支する腕部18、18との間部分に、薄肉部21、21を形成して、この間部分の曲げ剛性を低下させている。この間部分の曲げ剛性を低下させる為、第二の通孔19（図3）に代えて薄肉部21、21を形成した点以外の構成及び作用は、前述した第2例と同様である。尚、上述した実施の形態の第1～4例は、適宜組み合わせる事で実施する事もできる。又、シャフト7の断面形状に関しても、互いに平行な1対の外側平面14、14を有するものに限らず、六角形、セレーションを形成した多角形断面等、他の断面形状を有する構造にも実施可能である。

【0023】

【発明の効果】本発明のシャフトと自在継手のヨークとの結合部は、以上に述べた通り構成され作用するので、抑えボルトを緊締するトルクを特に大きくしなくても、シャフトとヨークとを確実に結合固定して、長期間に互る使用によってもがたつきを発生しにくくできる。又、シャフトとヨークとの結合作業も容易になる。更に、ヨークを構成する金属板の厚さを大きくしたり、或は硬度

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を高くしてもヨークとシャフトとの結合を確実に行なえる為、ヨーク全体としての強度向上を図れる。

【図面の簡単な説明】

【図1】本発明の実施の形態の第1例を示す、ヨークを組み込んだ自在継手の部分側面図。

【図2】一部を省略して図1の右方から見た図。

【図3】本発明の実施の形態の第2例を示す、ヨークの側面図。

【図4】同第3例を示す、図2と同様の図。

【図5】同第4例を示す、図1と同様の図。

【図6】本発明の対象となる構造で、シャフトの端部とヨークの基端部とを結合する状態を示す側面図。

【図7】図6のA-A断面図。

【図8】同B-B断面図。

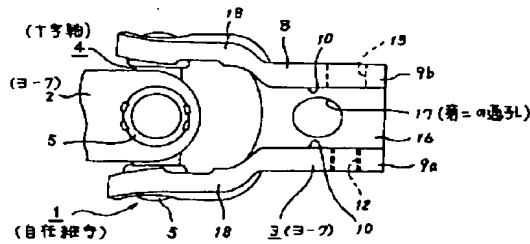
【図9】従来構造の別例を示す、図1と同様の図。

【図10】ヨークの基端部とシャフトの端部との寸法関係を示す断面図。

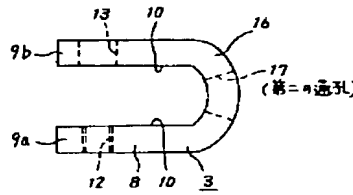
【符号の説明】

- \* 1 自在継手
- 2、3 ヨーク
- 4 十字軸
- 5 軸受カップ
- 6、7 シャフト
- 8 基端部
- 9a、9b 抑え板部
- 10 抑え面
- 11 ナット
- 12 ねじ孔
- 13 通孔
- 14 外側平面
- 15 切り欠き
- 16 連結部
- 17 第二の通孔
- 18 腕部
- 19 第二の通孔
- \* 20、21 薄肉部

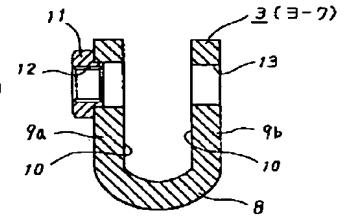
【図1】



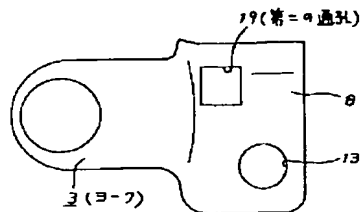
【図2】



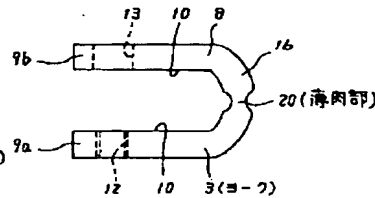
【図7】



【図3】



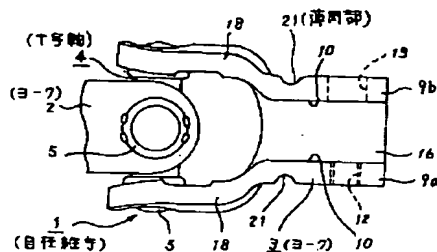
【図4】



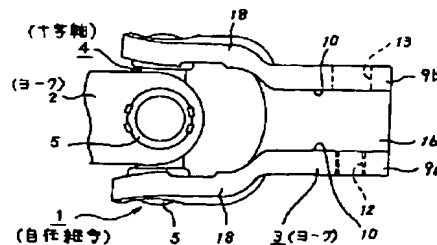
【図8】



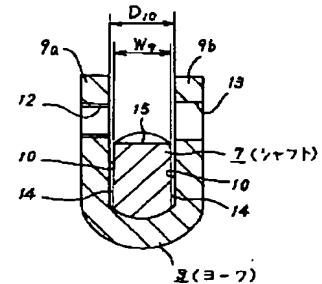
【図5】



【図9】



【図10】





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